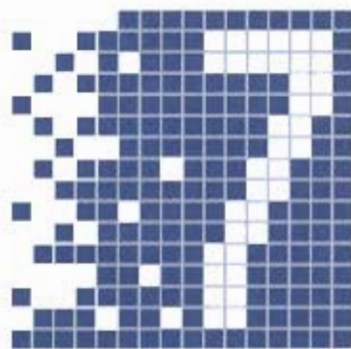# COLOR IN ICONS

In the design of icons, color plays a somewhat ambiguous role. Used properly, color can communicate. Used carelessly, it can confuse. Color can make the message clear or hopelessly opaque. It can delight and entertain, or distract and annoy. Color can make the most important information pop out, or it can make everything illegible. The effect of color depends entirely on where and how you use it. Let's see how to use color effectively in icons.

Note: In this book I use the word *color* in its everyday sense, that is, a difference in hue (green vs. red vs. yellow) or a noticeable difference in a combination of hue, lightness, and saturation. Technically this is called chromatic *color*.

RULE ONE: DESIGN IN BLACK AND WHITE FIRST

It is ironic but usually the best way to use color is first to avoid it. Icon designers could bypass 95 percent of the problems of using color and reap 95 percent of its benefits by following this simple rule:

> **First, make your icon work in black and white.**
> **Then, add color to make it work better.**

When I asked designers of successful icons what advice they would offer their less experienced colleagues, almost all of them included some variation of this rule.

This rule leads us to express the primary message of the icon in light-dark contrast and reserve variations in hue and saturation for amplifying the primary message or expressing secondary messages.

Icons in black and white overcome several common problems caused by color:

- **Color blindness**. If you can see, you can see black and white. Yet 5 to 10 percent of men and 0.25 to 0.5 percent of women are red-green color blind.

- **Low quality display**. Poorly calibrated display monitors make viewing and recognizing color icons difficult. Poor convergence blurs images and adds color fringes. Low contrast clouds the image.

- **Small images**. Tiny icons or those read at a distance require high contrast. The part of the human eye that perceives details is most sensitive to differences in lightness.

- **Imperfect viewing conditions**. Icons viewed obliquely, as when users share a screen, are harder to recognize. Screen glare robs the screen of contrast and compounds all the other problems of legibility.

Use color redundantly

The color figures can be found on the color plate in this chapter. The images within the text are just placeholders.

Never use color as the only means to convey a critical or primary message. Without color, can you reliably tell which of these is which?

Color Figure 5: Color as sole identifier

Blood   Water

Or, could you pick the correct season from these leaves?

Color Figure 6: Color as sole identifier

Spring   Summer   Autumn   Winter

Say it in black and white and then use color to reinforce, amplify, and support the original message. If color is the only distinguishing characteristic for an icon, give the icon an unmistakable text label.

Select robust color combinations

As you incorporate colors into your design, you must select colors that maintain the light-dark contrast of the original black-and-white design. These high-contrast designs work well over a wide range of colors and gray levels. Icons designed without sufficient contrast lose legibility when displayed on systems with fewer colors or gray levels than intended. This problem often occurs when icons are designed on one system and then converted for use on another one that defines colors differently.

Notice what happens when these two icons for books are designed with different color schemes:

Color Figure 8: Depend on contrast not color

✘ No   ✔ Yes

High contrast   Low contrast

See how they appear when displayed on screens with different numbers of colors:

Color figure 9: Different display levels

Levels	Color		Gray	
256				
16				
4				
2	Black and white only			

The icon with high foreground-background contrast remains legible under all conditions. The same is not true of the low-contrast icon.

DECIDE WHY YOU ARE USING COLOR

In designing computer displays, there are several good reasons to use color. Users can find and extract information quicker from colored displays. Color can add excitement and fun to an otherwise drab display. However, the way we use color to liven up a display can conflict with the ways we use it to speed up search.

In general, you can use color for one purpose in an icon and for only one or two purposes in a group of icons displayed together. Your first step in incorporating color into your icons is to decide why you want to use color. Be careful not to have conflicting purposes. Study this list and pick the one or two most important reasons for using color:

- **To direct attention**. Color can ensure that users notice and attend to critical icons or small details within an icon.

- **To speed search**. Color helps users find information quickly. Color coding can reduce the time required to find an item in a complex display. Color coding is more effective than coding by shape, brightness, or other techniques.

- **To aid recognition**. Realistic colors help users recognize an icon. Colors can also reduce the jagged edges which interfere with recognizing small images.

- **To show organization**. Color helps users distinguish and understand items in a complex display. Users can then make decisions faster and more accurately.

- **To rate or quantify**. Color can express numerical relationships. It can rank items in order and can express a value along a scale, though not precisely.

- **To represent color itself**. When users must apply, define, or edit a color, they want to see the color. The words *pale aquamarine* are no substitute for a swatch of the color.

- **To attract and please users**. Users prefer color displays. In survey after survey users say color displays improve their performance and confidence and reduces eye strain and discomfort.

- **To reinforce or arouse an emotion**. Color can shape our feelings toward an idea and can represent emotions directly.

The rest of this section suggests ways to use color for each of these purposes.

To direct attention

Color can direct the user's gaze to specific icons or specific objects within the icon. It can change the apparent importance of icons and objects.

To call attention to a small item

To make a small item stand out, give it a conspicuous color. Pick a color that contrasts with the background and is distinctive from the color of other objects:

Color figure 7: Color focuses attention

Press **this**
button

Book **mark**,
not the book

Ensure a foreground-to-background contrast ratio of at least 7 to 1. Use a bright, saturated color for the object you want to emphasize and display everything else in neutral colors. Draw the emphasized object as large as possible. Otherwise, users may not notice the colors. Try to make the object at least 5 x 5 pixels in size.

## To emphasize an area or group of icons

When emphasizing a larger area of the display or when showing an ongoing theme or general category, use paler or darker colors. Large areas of pure, saturated color overwhelm and tire users. For small items, such as individual icons, use bright, pure, high-contrast colors. For larger areas, use lower-contrast, more *neutral colors*.

To deemphasize an object

To deemphasize, hide, or camouflage an object. Fade it into the background. Give it a color close to that of the background. Select a similar hue and lower the lightness difference between the object and its background.

To speed search

Color can greatly reduce the time required to find an item in a complex display:

Color figure 24: Color aids search
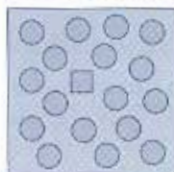
Find the square
here

Find the yellow
circle here

For the quickest search:

- Display the icon you want the user to notice in a unique color. Minimize the number of other icons and objects in that color.

- Use as few colors as possible. If icons are close together, you can use about 7 colors. If not, limit yourself to 4 colors.

- Teach or tell the user what color to search for.

- Select color codes that represent characteristics of the icons. Make sure these characteristics are meaningful to the user.

Color coding can fail if you use too many colors, or if there are too many items in each color.

To aid recognition

Color helps us recognize objects. Objects displayed in familiar colors are recognized more quickly than those without color, and much better than those in unexpected colors. Color must be plausible, but it need not be highly accurate. Only images of foods and faces require high-fidelity color. Most other objects remain recognizable provided we maintain the relative color differences among their parts.

For quickest recognition display the icon in sterotypical colors. Show an object the way users expect the object to be colored—even if the expectation is unrealistic. Remember:

Roses are red.
Violets are blue
At least on maps,
Rivers are too.

Here are some examples of the use of expected colors in icons:

Color figure 15: Expected colors


Printout   First aid   Fire   Faucet   Road

Use colors traditionally associated with an object. Show the color of the most common, most widely used, and best established version of an object:

Color figure 16: Color identifies object

| Pencil | Eraser | Flashlight | Highlighter | Palette |

Use conventional colors for established symbols. Whenever you use traffic or safety signs in icons, show them in their conventional colors:

Color figure 17: Conventional colors in signs

| Caution | No | Stop | Radioactive | Electrical hazzard | First aid |
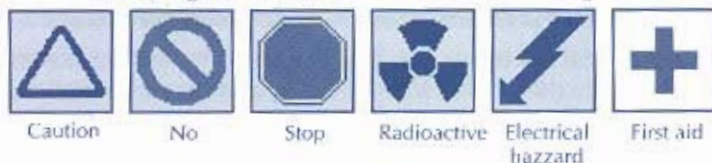
To show organization

Color can be effectively used to categorize and group. It can show which icons are similar and which are different. We naturally see items of the same color as a group. To show that separate icons are of the same type, class, or category, display them with the same color. You can show up to 6 or 7 categories provided you use a distinct color for each. Display similar icons in similar but distinguishable colors. Use very different colors to represent dissimilar concepts. For mutually exclusive categories, use complementary colors.

Color effectively shows which objects are the same or similar and which are different:

Color figure 18: Color categorizes

| Retouch | Design | Paint | Repair | Measure | Attach |

To rate or quantify

Color can suggest a ranking or sequential order among separate items and can represent a numerical value within a range.

To rank items

To imply an order or ranking among a group of icons, assign them colors varying in lightness, not just hue. One of the most common mistakes in color coding is to use the color spectrum to imply an order. This scale, which arranges colors as they occur in a rainbow, is not immediately recognized. Users must memorize it:

Color figure 10: Spectral order

The color scale also progresses from dark colors to light and back to dark again, providing conflicting clues. Fortunately, there are three scales that avoid these problems. One is the scale of lightness. Select a single hue and vary its lightness:

Color figure 11: Lightness scale

The other scales rely on the subjective "temperature" of different hues. They arrange colors in order from cold to hot. One temperature scale spans the cool colors from violet to yellow:

Color figure 12: Cool scale

The other spans the warm colors from yellow to red:

Color figure 13: Warm scale

The entire hot-cold range is split into two scales since each half is also a scale of lightness.

To express a range of values

Color can express a numerical value within a range—but only approximately. Use a continuous mixture of colors between two extremes. For example, to represent temperature, use a range of colors from deep blue to bright red. Notice how the shape reinforces the color, and that the icon works in both black and white as well:

Color figure 25: Color as secondary cue

Cold   Moderate   Hot

If the range spans both positive and negative numbers, use a cool color for negative values, a warm color for the positive values, and a neutral color for the zero point.

Although users can infer the general value from a color, do not rely on color alone to express a value. Color is best used to reinforce a value expressed more precisely by some other means:

Color figure 19: Color reflects sound level

Off   1   2   3   4   5
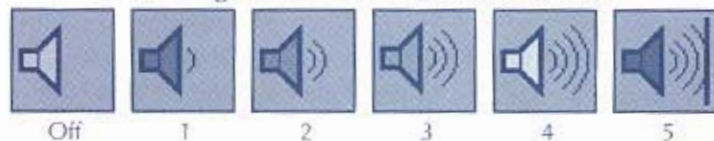
To represent color itself

The most direct, most obvious, most natural use of color is to represent color itself. Applications for mapping, illustration, photo retouching, presentation graphics, and other business activities often require users to select, apply, and edit colors. These applications must show the colors the user is working with. Phrases such as *deep red* and *bluish green* are too vague.

Icons can include swatches of color to show the currently active or selected color. For example, these drawing tools each show the color applied by each tool. If the color assigned to a tool changes, the color in its icon changes:

Color figure 20: Color represents color

Changing the color of parts of an icon to show color assignments takes some programming finesse and on some systems may prove impossible. In most cases, however, the background color of icons can be changed to reflect color assignments.

For the most accurate perception, display the sample color against a black, white, or gray background. Also, make the area of color large enough that the user can see it clearly, at least a 5 x 5-pixel area. Otherwise display a separate swatch of the color elsewhere on the display and use color in the icon only as a reminder for the user.

To attract and please users

We all like some colors better than others. Designers who ignore the subjective and aesthetic effects of color are as remiss as those who consider only their own tastes in color.

Reactions to color are so subjective and personal that we may never have exact rules for selecting colors. The best we can strive for are guidelines for using colors in ways that offend few people and unify rather than disrupt the design.

Balance colors

Staring at a large area of one color for long periods of time dulls the user's ability to perceive that color. Most people, thus, find balanced color combinations more comfortable. Screen colors are balanced if the red-green-blue values of pixels throughout the screen average out to a neutral gray. To balance colors:

- **Mix colors with different characteristics**. Use warm colors to balance cool colors and dark colors to offset bright colors.

- **Select colors equally spaced around a common color harmony wheel**:

Color figure 22: Distinct colors

- **Use pure, bright colors only over small areas**. An icon is a small area. Cover large areas, such as the surface of a menu, with a neutral color like gray or white. If you must use color over a large area, use a pale or a dark hue.

Avoid garish colors

You cannot please everyone—at least in your choice of colors. You can, however, avoid offending many. Put your own subjective preferences aside and select colors based on research and common sense:

- **Limit use of bright, primary colors** unless your program is used by children. Reserve these colors for accenting and highlighting small objects or individual icons.

- **Pick colors that most users like**. Western adult viewers prefer colors in this order: blue, red, green, purple, orange, and yellow.

- **Use colors found in nature**. They seldom offend.

- **Select proven colors and combinations**. Pick colors that have been popular for many years and in different cultures.

- **Avoid trendy, vogue color schemes** unless you plan to redesign your icons every year or so.

Avoid conflicting colors

Unless designers create icons and screens with a simple, consistent color scheme, the screen becomes a babbling riot of contending colors:

- **Do not overwhelm subtle color icons** with bright borders and brilliant backgrounds.

- **Avoid juxtaposing spectrally distant colors** like red and blue.

- **Limit your use of opponent color combinations**, such as blue and yellow, green and red, and green and blue. Such combinations produce afterimages and indistinct edges.

To reinforce or arouse emotions

The ability of color to arouse emotions has long been documented. Color affects blood circulation and pressure, respiration rate, muscular strength, brainwave activity, and electrical conductance of the skin. The strength and direction of the effect vary with the different colors. We can use colors to moderate the emotional state of the user:

```
To arouse,                              To calm,
alert, and                              soothe, and
excite                                  reassure

◄──  Red    Orange    Yellow    Green    Blue  ──►
```

People's reactions to colors have been studied since cave dwellers first decorated their walls with images of bison and hunters. Some common emotional associations have been observed:

Color	Associations
Red	Aggression, impulsiveness, warmth, extroversion, crudeness, optimism, danger, shame
Orange	Friendliness, congeniality, deference, warmth, pride, gregariousness
Yellow	Novelty, idealism, introspection, warmth, caution, betrayal, cowardice
Green	Freshness, hope, health, prosperity, envy, jealousy, madness, nausea, approval
Blue	Cold, calm, truth, innocence, precision, doubt, depression, hopelessness
Purple	Vanity, wit, nostalgia, spirituality, resignation, regret
Brown	Duty, parsimony, reliability, earthiness, barrenness, poverty
Gold	Richness, wisdom, honor, high quality, haughtiness, vainglory, power
White	Lightness, innocence, purity, wisdom, truth, cold, ghostliness, void
Gray	Restraint, neutrality, barrenness, grief, indifference, inertia, maturity
Black	Death, grief, morbidity, gloom, despair, dignity, solemnity, sin, negation

CHOOSING COLORS

Once you have decided why to use color and have considered the requirements of color for that purpose, you must select the actual colors to use. In some cases the choice is obvious: If you are using color to represent colors, you simply make your colors the same as those they represent. For making objects recognizable, you pick realistic colors consistent with the user's expectations. For other purposes, especially those involving color coding, you must often balance conflicting requirements.

Use as few colors as you can

Computers can display millions of colors, but how many should we use in icons? Only as many as we need. As we use more colors, each color becomes less distinct. The more colors we put in a display, the slower and less certainly the user reacts to each.

So, how many colors do we need? The number varies with the reasons for using color. Here are some general guidelines:

Reason for using color		Number of colors
Best legibility		black and white
Fastest search	Over entire display	3 to 4
	Close together	6 to 7
Recognizable images	Faces and foods	100+
	Other objects	20-50

Rely on learned associations

Select colors whose meanings users have already learned. Avoid using colors in ways that conflict with common associations for colors.

Color associations learned from nature are reliably understood worldwide. Consider these common meanings for color:

Color	Meaning	Associated with
Red	Danger	Blood
	Heat	Fire
Yellow	Warmth	Sun
Blue	Cool	Water
Green	Life, youth	Young leaves
Brown	Age, death, earth, soil	Dying vegetation
Paler colors	Distance	Atmospheric haze

Consistently warm colors suggest activity and excitement, and cool colors suggest quiet and calm.

Where natural associations do not apply, we can draw on broadly followed conventions for color meanings. Safety warnings and road signs provide a consistent model to follow:

Color	Safety signs	Traffic signs
Red	Danger, stop	Danger, warning, no
Orange	Dangerous parts of equipment	Cautionary
Yellow	Cautions	Cautionary, important
Blue	Non-safety messages	Information, yes
Green	Safety	Go
Black on yellow	Radiation	
Black on white	Traffic markings	

Notice how analogous colors are used to show the remaining charge in a battery:

Color figure 26: Color represents range of values

OK   Low   Empty

If no general conventions apply, we may look for associations prevalent in the discipline or business of users. An accounting program could, for example, use red as a symbol for financial loss.

Pick harmonious colors

There is no magic recipe for picking harmonious color combinations. Yet a simple technique combined with a selective eye yields usable combinations.

For distinct hues

To pick a few, distinct, harmonious colors, select colors from symmetrical positions around a traditional color harmony wheel. For two colors, this procedure yields complementary colors. For any number of colors it ensures that the colors are distinct from one another.

Color figure 22: Distinct colors

For similar hues

For similar hues, pick colors from adjacent slots on the color wheel, for instance:

Color figure 23: Similar colors

Varying lightness

Instead of picking harmonious hues, you can pick a single hue, such as green, and vary the lightness of that hue:
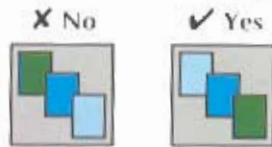
Color figure 11: Lightness scale

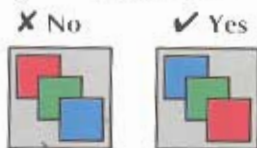**Color figure 1: Color draws attention**
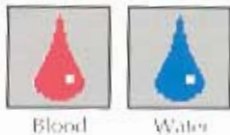

Color figure 2: Aerial perspective

✗ No   ✔ Yes

Color figure 3: Color-depth effect

Color figure 4: Color suggests distance

✗ No   ✔ Yes

Color Figure 5: Color as sole identifier

Blood   Water

Color Figure 6: Color as sole identifier
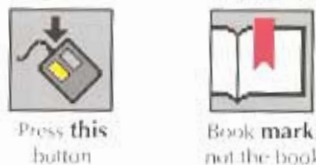
Spring   Summer   Autumn   Winter

Color figure 7: Color focuses attention

Press **this** button   Book **mark**, not the book

Color Figure 8: Depend on contrast not color

✗ No   ✔ Yes

High contrast   Low contrast
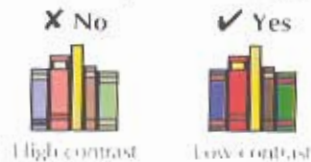
Color figure 9: Different display levels

Levels	Color		Gray	
256				
16				
4				
2	Black and white only			

Color figure 10: Spectral order

Color figure 11: Lightness scale

Color figure 12: Cool scale

Color figure 13: Warm scale

Color figure 14: Saturation scale

Color figure 15: Expected colors

Printout   First aid   Fire   Faucet   Road

Color figure 16: Color identifies object

Pencil   Eraser   Flashlight   Highlighter   Palette

Color figure 17: Conventional colors in signs

Caution   No   Stop   Radioactive   Electrical hazard   First aid

Color figure 18: Color categorizes

Retouch   Design   Paint   Repair   Measure   Attach
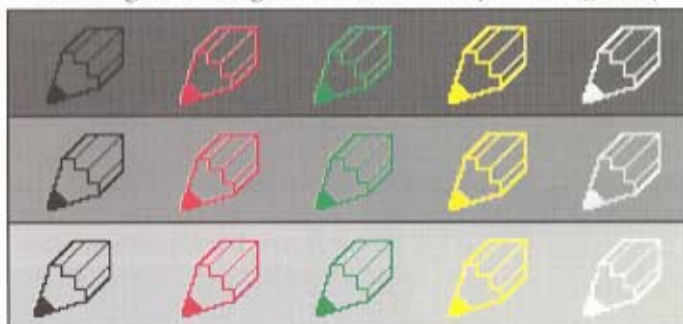
Color figure 19: Color reflects sound level

Off   1   2   3   4   5
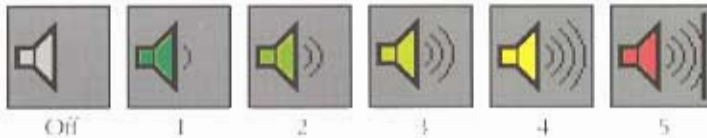
Color figure 20: Color represents color

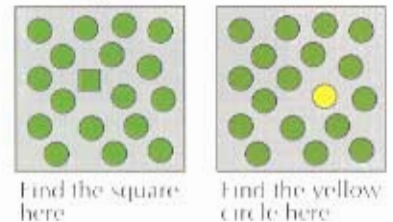## Color figure 21: Lightness contrast improves legibility

Color figure 22: Distinct colors

Color figure 23: Similar colors

Color figure 24: Color aids search

Find the square here   Find the yellow circle here

Color figure 25: Color as secondary cue

Cold   Moderate   Hot

Color figure 26: Color represents range of values

OK   Low   Empty

Varying saturation

Another set of harmonious colors results from varying the saturation or purity of a color:

Color figure 14: Saturation scale

Because such colors do not vary in lightness, they will be impossible to distinguish on gray-scale monitors and can pose problems for color-blind users.

Pick colors systematically

Assign colors in a meaningful way. First decide why to use color, then how to, and which colors. Here is an example of the process of selecting colors for an application.

| Step	Action	Example
1	Decide why you are using colors. Select one primary purpose.	The application controls flow through the pipes of a computer-controlled refinery. We want to color code icons to reflect the function they trigger.
2	Specify the categories you need to represent. This lets you know how many colors you need.	Commands perform four kinds of functions: (1) open valves, (2) close valves, (3) restrict the flow through pipes, and (4) label pipes and valves with descriptive information.
3	Select candidate colors	We pick red, green, blue, and yellow.
4	Make tentative assignments based on common associations of the colors.	On traffic signs these colors have these meanings. red = stop green = go yellow = slow blue = information
5	Fix specific assignments in the context of the assignment.	By analogy we use red for icons that close pipes, green for icons that open pipes, yellow for icons that restrict flow, and blue for icons that annotate the display.

AVOID COMMON PROBLEMS

Careless or haphazard use of color leads to problems. We can overcome these problems by understanding them and taking steps to avoid them.

Ensure legibility

Color can reduce legibility. Color-on-color displays lacking lightness contrast make icons, thin lines, and text hard to see. Because of misregistration, color can also produce fuzzy edges, especially at the edges and corners of the screen. If you must use color for icons, follow these guidelines:

- **Maintain a high tonal contrast between foreground and background.** Avoid low-contrast color combinations such as dark blue on black and yellow on white. On a light background, use a dark color, such as red or blue. For a dark background either use a light color like yellow or green or else use a pale tint of a color:

Color figure 21: Lightness contrast improves legibility
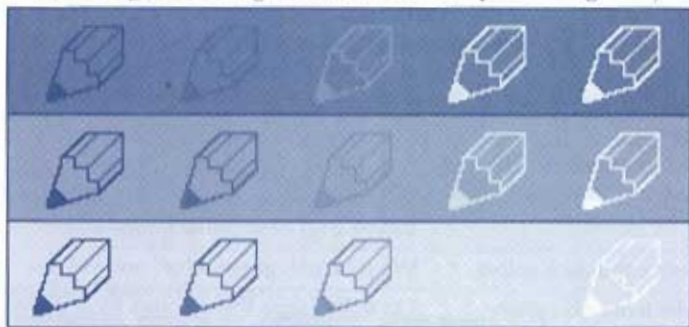
- **Lighten dark pure colors like red and blue when they appear on a dark background.** Likewise darken light colors, such as yellow and green, when they occur on a light background.

- **Use pure blue as a background only** since many people cannot focus clearly on small blue objects.

- **Do not put pure red and blue side by side.** Red objects appear nearer than blue ones. Using red and blue together creates an illusion of depth.

Do not distract viewers

Excessive and irrelevant color distracts users and makes finding information on the screen harder and less reliable. The distraction of meaningless color disrupts the user's visual scanning patterns. To avoid the disruptive effects of color:

- **Use few colors.** The more colors you use, the longer the user takes to respond to each and the greater the confusion between colors.

- **Use bright, conspicuous colors only for icons that need extra attention.**

- **Use color only where its meaning is clear to the user.**

Compensate for color blindness

Although only one person in 30,000 is totally color blind, many do have problems with certain colors. About 8 percent of men and 0.4 percent of women have trouble distinguishing red and green. Most of us are blue-blind in the very center of our field of vision where we perceive fine details such as icons. Because of yellowing of the lens of the eye, this difficulty seeing pure blue increases as we age.

To overcome the problems caused by color blindness:

- **Use color redundantly.** Use color only to repeat or reinforce messages expressed in black and white.

- **Take care with problem colors.** Avoid using red vs. green for any critical distinction. Use pure blue as a background only.

- **Vary lightness contrast.** Use color combinations that differ in value, not just in hue. Consider a bright yellow, a *medium green, and a dark red.*

- **Pick colors most can distinguish.** Distinctive combinations include red and blue, red and cyan, blue and yellow.

- **Use just a few colors.** Limit how many colors users must distinguish.

- **Keep colors to be compared near one another.** Locate color legends near the colors they decode.